Inequalities in Health: The Value of Sex-Related Indicators

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My laboratory has previously shown that the sex differences in tumor incidence in Europe can be related to the female social condition and that the pattern of this relationship varies according to the different historical contexts. In this article, I have extended the study worldwide to all cancer registries, and I present the sex differences in life expectancy at birth. A close link between the health of the populations and socioeconomic and cultural factors was confirmed. The sex-related indicators had a distribution independent from the parent variables cancer incidence and life expectancy; thus, they carry complementary information and provide an additional, sensitive probe for monitoring the health of the populations. *Key words:* cancer, cultural factors, epidemiology, health inequality, indicator, life expectancy, sex, social conditions, socioeconomic factors. ***Environ Health Perspect* 111:421–425 (2003). doi:10.1289/ehp.5698 available via *http://dx.doi.org/*** [Online 1 November 2002]

Inequalities in health continue to be a major problem in the world. Health differences exist between sexes, between social groups within countries, and between countries. The patterns of these health differences change as living conditions evolve (Hertzman and Siddiqi 2000; Marmot and Bobak 2000; Marmot and Feeney 1997; Tomatis 2001), as demonstrated by the sharp decline in life expectancy—as well as the widening gap of life expectancy between sexes—in Eastern Europe during the recent political transition (Marmot and Bobak 2000; Nolte et al. 2000a, 2000b). Thus, observing inequalities in health allows us to better understand how changes in society translate into changes in health. For their universal relevance, the health inequalities between sexes are of particular importance. In previous reports, my laboratory has shown that the sex differences in tumor incidence between European countries can be related to the female social condition: the greater the social equality between males and females, the lower the difference in cancer incidence between the sexes. The female condition was measured by a quantitative sociologic index. However, the study of regional variations in Italy has indicated that this process follows different pathways in different countries, thus requiring explanations rooted in socioeconomic and historical contexts (Benigni et al. 2000, 2001). In this article, I have extended the study of sex differences in cancer incidence worldwide to all cancer registries; a larger perspective is also gained by considering the sex differences in life expectancy at birth.

Data and Analysis

Data. The global cancer incidence (age standardized rate per 10,000 inhabitants) for males and females was retrieved from the compilation of cancer registries of the International Agency for Research on Cancer (Parkin et al. 1997). The life expectancy at birth was retrieved from the *Encyclopedia Britannica* (2000).

The sex differences were expressed as normalized indices:

$$\Delta N = \left(\frac{\text{male cancer incidence} - \text{female cancer incidence}}{\text{male cancer incidence}}\right)$$

$$\Delta LIFE = \left(\frac{\text{female life expectancy} - \text{male life expectancy}}{\text{male life expectancy}}\right)$$

For both indices, positive values indicate male disadvantage, whereas negative values indicate female disadvantage.

Strategy of the analysis. This study consists of three separate analyses. In the first analysis, I considered the distributions of the ΔN values, relative to 183 cancer registries from 50 countries. The subject of the second analysis was the distribution of the ΔLIFE values in 139 countries; in this case, one ΔLIFE value corresponded to one country. The reasons for keeping the first and second analyses separate was that the data available were classified differently (regions and countries, respectively). Therefore, separate analyses were more adequate for using all of the available information.

The third analysis compared the distributions of ΔLIFE, ΔN, cancer incidence (male and female separately), and life expectancy (male and female separately). This analysis was performed at the level of the least detailed variable, that is, at the country level. The ΔN and the cancer incidence values were averaged by country. The countries (statistical units) considered in this third analysis were those with values in all six variables ($n = 50$).

Table 1 shows the ΔLIFE values and the ΔN values averaged by country. The ΔN values for the cancer registries are available from the author on request.

Results and Discussion

Sex difference in cancer incidence. An inspection of the ΔN values (standardized sex difference in cancer incidence) points to the complexity of interpreting the modulating factors. For example, cancer registries from three extremely different countries, such as Brazil, Uganda, and Sweden, are in a very narrow interval of ΔN (Goiania, Brazil, 0.071; Kyadondo, Uganda, 0.073; Sweden, 0.074). The differences in society, culture, and economic development make it difficult to find a common explanation. However, underlying regularities start to emerge when the data are grouped into geographical areas (Figure 1). An analysis of variance confirmed the effect of the geographical distribution on ΔN ($F = 17.30$; $p < 0.0001$).

Previous work from my laboratory (Benigni et al. 2000, 2001) has shown that the distribution of tumor profiles in Europe closely follows the cultural (historical) geography of the continent and that the sex differences in cancer incidence parallel a socioeconomic indicator of the female condition. The starting hypothesis of this work is that cultural/socioeconomic factors influence the ΔN distribution worldwide. The geographic repartition selected for the cancer registries (Figure 1) that I had subjectively decided upon follows the general lines of the cultural/socioeconomic repartition accepted by modern historical research. Such historians as Fernand Braudel have expanded on the existence of clearly recognizable “civilizations”; these are able to maintain their specificity in fields ranging from everyday life to art and culture over extremely long periods of time (Braudel 1972, 1981, 1995). Within this perspective, the geographic classification selected in this work is a proxy for a cultural/socioeconomic classification of the cancer registries’ areas.

The numerosity and representativity of the available cancer registries also put constraints on the geographical classification. Using all of this information, I based the classification on seven areas. South Asia and East Asia are clearly characterized (Figure 2). Latin America includes Costa Rica, Puerto Rico, and South America. Pacific registries are available only from Australia, New Zealand, and Philippines. African and Middle Eastern registries were collected together only because of the paucity of the data points. European and North American countries could have been collected under the same heading; however, they

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Received 10 April 2002; accepted 18 October 2002.